m RFC Details: #101711780

& State: RFC Closed

| Plant | Metropolis | | Operating Area | LF2 | ্ধি Sub Area |
|---|------------|----------------|----------------|------------|--------------|
| $\overset{\mathfrak{g}}{	riangle}$ Originator | Powers, Br | ent (e362942) | Date Initiated | 01/19/2010 | |
| Required Start-u | p Date | Type of Change | Duration | of Change | Priority |
| 03/15/2010 | | Procedure | Permanen | t | Schedule |
| Closure Date | | | | | |
| 04/16/2010 | | | | | |
| Work Start Date | | | | | |
| 03/08/2010 | | | | | |

View Checklist

Description and Technical Basis for Change

Minor changes to LF2 procedure MTW-SOP-LF2-9016, R3, LF2 Section 16 - Introduction. The changes are as follows: Section 16.2.5 was updated to reflect the nitrogen operating pressure on the cold trap now as about 15-20 psig instead of 30 psig. Section 16.2.8.2 changed the pump number from P0270 to P-270.

團 Phase Details(Area Leader to Approve Document Phase)

| Phase Description | | Due Date | Completion/Completion Date | Comments | Implementation/Impl.Date | Comments |
|---------------------|--|------------|----------------------------|----------|--------------------------|----------|
| Phase 1 Description | Minor changes to LF2 procedure MTW-SOP-LF2-9016, R3, LF2 Section 16 - Introduction. The changes are as follows: Section 16.2.5 was updated to reflect the nitrogen operating pressure on the cold trap now as about 15-20 psig instead of 30 psig. Section 16.2.8.2 changed the pump number from P0270 to P-270. | 03/15/2010 | 01/29/2010 | Q.SN\ | 8 99 O'NA | None |

Documentation

Uploaded Documents

JVUE Document Name

Document Type

Completed Training Documents

Powers, Brent (e362942)

01/19/2010

General

MTWSOPLF29016R3LF2SECTION16INTRODUCTION.pdf Supporting Documents Powers, Brent (e362942) 01/19/2010

🖁 🖻 Area Approvals

| Primary Approval | | PHA Required | | | Operator Training | ? Help |
|------------------|----------------------------------|-----------------|---|------|-------------------|--------|
| 🚨 Area Leader | Babcock, Kenneth (e331236) | No [©] | PHA Post- Startup Recommendations | | 1-Way Comments | None |
| ⊡> Status | Approved | | Complete | | | |
| Date of Approval | 01/21/2010 | Comments | | None | • | |
| Comments | None | | | | | |

Department Approvals

| Department | Approva | al Reqd | Approval Status | Approval Date | Approver | Delegate To | | Comments |
|--|----------|----------|--------------------|------------------|--------------------------------------|----------------|---|----------|
| | Yes | No | | | | | | |
| Metropolis Owning Department - Mandatory | 1 | | Approved | 01/26/2010 | Babcock, Kenneth (e331236) | - | ~ | None |
| Metropolis Engineering - Mandatory | ✓ | | Approved | 01/22/2010 | Wolf, Mark (e424037) | • | - | None |
| Metropolis Health, Safety & Environmental - Mandatory | * | | Approved | 01/22/2010 | Burgess, Holly (e215926) | - | - | None |
| Automation Department | | ✓ | - | - | Perriello, Bryan (e425548) | - | - | - |
| Health Physics | ✓ | | Approved | 01/24/2010 | Stokes, Robert (e325280) | - | - | None |
| Environmental | * | | Approved | 01/22/2010 | Thomas, Richard (e461463) | - | - | None |
| Regulatory Affairs - Right of Approval | · 🗸 | | Approved | 01/22/2010 | Litinski, Lidia (e325566) | - | - | None |
| Maintenance and Reliability | ✓ | | Approved | 01/23/2010 | Barnes, Tommy (e418782) | - | - | None |
| ☐ IT department | | √ | - | - | Hamby, Gary (e031332) | - | - | <u>.</u> |
| Plant Mgr | · | | - | - | Palmer, Dean (e670614) | - | - | - |
| External Approvers | | 1 | - | - | Bonfiglio, Salvatore (e308780) | - | - | - |
| Quality | | ~ | • | - | Cybulski, Jason (e077889) | - | - | - |

PSSR Approvals

| Department | PSSR Red | qd | Phase | Approval Status | Approval Date | Approver | PSSR Responsibility | PSV Status | PSV Responsibility |
|---|----------|----|-------|--------------------|------------------|-------------------------------|----------------------------|-----------------|-----------------------|
| | Yes | No | | | | | | | |
| Metropolis Owning Department - Mandatory | ✓ | | 1 | <u>Approved</u> | 04/12/2010 | Powers, Brent (e362942) | Powers, Brent (e362942) | <u>Approved</u> | |
| Metropolis Engineering - | ✓ | | 1 | Approved | 02/01/2010 | Ignao, Danilo (e016300) | Ignao, Danilo (e016300) | Approved | |

| Mandatory | | | | | | | | |
|--|---|---|---|-----------------|------------|---------------------------------|----------------------------------|-----------------|
| 回 Metropolis Health, Safety & Environmental - Mandatory | 1 | | 1 | <u>Approved</u> | 02/01/2010 | Burgess, Holly (e215926) | Burgess, Holly (e215926) | <u>Approved</u> |
| Automation Department | | ✓ | 1 | | | | Perriello, Bryan (e425548) | |
| Health Physics | ✓ | | 1 | <u>Approved</u> | 02/01/2010 | Stokes, Robert (e325280) | Stokes, Robert (e325280) | Approved |
| Environmental | ✓ | | 1 | Approved | 02/01/2010 | Thomas, Richard (e461463) | Thomas, Richard (e461463) | Approved |
| Regulatory Affairs - Right of Approval | ✓ | | 1 | Approved | 01/29/2010 | Litinski, Lidia (e325566) | Litinski, Lidia (e325566) | <u>Approved</u> |
| Maintenance and Reliability | ✓ | | 1 | <u>Approved</u> | 01/30/2010 | Barnes, Tommy (e418782) | Barnes, Tommy (e418782) | Approved |
| ☐ IT department | | ✓ | 1 | | | | Hamby, Gary (e031332) | |
| Plant Mgr | | 4 | 1 | | | | Palmer, Dean (e670614) | |
| Quality | | 1 | 1 | | | | Cybulski, Jason (e077889) | |

Fields marked with $\boldsymbol{*}$ are mandatory

RFC Checklist

| Metr | opolis Owning Department - Mandatory | | | | | RFC# | 101711780 |
|------|--|------------------------|-------------------------------------|----------|---------|--------------------------|-----------|
| ا | Does this change impact? | PHA and/or PSI * | Secondary Department Approval | Comments | | | |
| (| Change to Standard Operating Procedure? | 1 | | | PSI | | |
| / | Will the change require a change to SOP's or documents in the DMS? | 1 | | | PSI | | |
| (| Change to Alarm settings -outside prior established safe operating range? | | Ý | | PSI-PHA | Automation Department | |
| (| Change to Sampling point or sampling procedure? | | 1 | | PSI-PHA | | |
| (| Change in Raw Material supplier/qualified vendor list? If so, include Product Steward approval. | , | V | | PSI | External Approvers | |
| | Change in Staffing requiring revision/review of 3 or more Standard Operating Procedures? | | Ý | | PSI-PHA | | |
| (| Change in Responsibilities of any direct supervisor? | | 1 | | PHA | | |
| (| Change in Raw Material package type or capacity (bag, drum, tanker, railcar)? | | ✓ | | PSI-PHA | | |
| (| Change in Maximum inventories (Vessels)? | | * | | PSI-PHA | External Approvers | |
| (| Change in Control Console/Display layout? | | \ | _ | , | Automation Department | |
| | Change in work process introduces a new hazard or potential exposure? If so, review the existing Job Safety Analysis (JSA) or conduct a JSA. | | ` | ı | PSI | | |
| l t | Does this change affect the way the raw materials, process variables (levels, temperatures, pressures, flows, etc.), products or by-products are measured or controlled? If so, include Automation approval. | | | | PSI | Automation Department | |
| | Change in byproduct handling and end-use? If so, include Product Steward approval. | | ✓ | | PSI-PHA | External Approvers | |
| | Use or change in tollers/contract manufacturers? If so, include Product Steward approval. | | ✓ | | PSI | External Approvers | |

* Whenever any item is marked "Yes" the Metropolis Owning Department - Mandatory must approve the change. Whenever an item maked "PSI" has a check in the "Yes"box, the Owning Department - Mandatory needs to complete a PSSR form.

| Ме | tropolis Engineering - Mandatory | | | | | RFC# | 101711780 | | |
|----|---|-----|----|--------------------|------------------------|--------------------------|-----------|--|--|
| | Does this change impact? | Yes | No | I don't know | PHA and/or PSI * | and/or Department | | | |
| | If this change introduces a new Digital Protective Control Device or a critical digital asset, can the device be remotely accessed or configured? | | ✓ | | | | | | |
| | Major change to Control strategy? | | ✓ | | PSI-PHA | Automation Department | | | |
| | Is any additional training required - operator, maintenance, safety, environmental, etc.? | | 1 | | PSI | | | | |
| | Change to Safety/Mitigation System design? | | < | | PSI-PHA | | | | |
| | Change to Process impacting Piping and Instrumentation Diagrams? | | | | PSI | | | | |

| 1 | 1, | Ī | I | I | 1 |
|--|----------|---|---------|--------------------------|----------|
| Change in Deadurt Consiliration of the change Deadurt Changed an array | √ | | PSI | <u></u> | |
| Change in Product Specifications? If so, include Product Steward approval. | | | 1981 | <u> </u> | <u> </u> |
| Change in manufacturing methods for cGMP product? If so, include Product Steward approval. | ✓ | | PSI | | |
| Change to Area electrical classification? | ✓ | | PSI | | |
| Change in Pressure Vessel status (re-rating)? | ✓ | | PSI-PHA | | |
| Change to Freeze Potential/Protection? | ✓ | | PSI | | |
| Change/Addition of Fire-Proofing? | ✓ | | PSI | | |
| Change to Ventilation or Exhaust System? | ✓ | | PSI | | · |
| Is an Extended PreStartup Safety Review required? (If the change includes physical modifications then answer YES) | ✓ | | PSI | | |
| Change to Equipment/Process Operational Limits? | ✓ | | PSI | | |
| Change involving Emergency shutoff valves/equipment or interlocks? | ✓ | | PSI-PHA | | |
| Will the proposed change have an impact on any hardware or software applications (DCS, PLC, etc)? | ✓ | | PSI | | |
| Do any other drawings or files need to be updated? (specify in Comment section) | ✓ | | PSI | | |
| Change to Transmitter scale range? | ✓ | | PSI | Automation Department | |
| Change to Reaction Chemistry/Formulation? If so, include Product Steward approval. | ✓ | | PSI-PHA | | |
| Is this a conceptual RFC. If so, do not mark DONE until an as-built RFC is completed. | ✓ | | PSI | | |
| Change to Process impacting Process Flow Diagrams (Batch Recipe)? | ✓ | | PSI | | |
| Change in the process, piping or storage configuration resulting in an intermediate becoming isolated? If so, include Product Steward approval. | ✓ | | PSI-PHA | External Approvers | |
| New raw material, product, intermediate, byproduct or waste material? If so, include Product Steward approval | 1 | | PSI-PHA | | |
| Change to Static Electricity Generation or Accumulation potential? | < | | | | |
| Change to Production facility maximum capacity (throughput)? If so, include Product Steward approval. | ✓ | | PSI-PHA | External Approvers | |
| Minor change to Control strategy? | 1 | | PSI | Automation Department | |
| Does the proposed change or modification introduce a new Digital Protective Control Device associated with a plant process, or a critical digital asset as defined in NEI guidance? | ~ | | | IT department | |
| Change to Material and Energy Balance? If so, include Product Steward approval. | 1 | | PSI | External Approvers | |
| Is there a possibility of product contamination from the new or modified equipment, e.g., grease, oil, incompatible chemicals, corrosion products from a different material of construction, etc.? | ~ | | РНА | | |
| Change/addition to equipment included in a Critical Equipment Database (Mechanical Integrity, Environmental, ISO)? | - ✓ | | PSI | | |
| Change in Raw Material supplier/qualified vendor list? If so, include Product Steward approval. | ✓ | | PSI | External Approvers | |
| Change of Relief Device design/capacity (including addition of isolation valve beneath)? | ✓ | | PSI-PHA | | |

* Whenever any item is marked "Yes" the Metropolis Engineering - Mandatory must approve the change. Whenever an item maked "PSI" has a check in the "Yes"box, the Engineering - Mandatory needs to complete a PSSR form.

| Does this change impact? | Yes | No | I don't know | PHA and/or PSI * | Secondary Department Approval | Commen |
|---|-----|----------|--------------------|------------------------|-------------------------------------|--|
| Potential release or increased emissions to air, water and/or soil? | | 1 | | PSI | | |
| Change in Hazard Class or additional toxic, reactive, corrosive or flammable material? If so, include Product Steward approval. | | √ | | PSI | External Approvers | |
| Change, addition, or relocation of Fire Protection equipment? | | V | | PSI-PHA | | • . |
| Is there a need for standby power? | | V | | PSI-PHA | | |
| Change affects the reporting status for CFATS DHS Chemicals of Interest? Sites outside the US please answer as NO. If YES, include both HSE (Sal Bonfiglio) and Security (James Sonntag) as External Approvers. | | √ | | PSI | External Approvers | |
| Change affects the quantity of an Extremely Hazardous Substance on site, either in pure state or in a mixture? Sites outside the US please answer as NO. | • | 1 | | PSI | | |
| Change in Equipment blanking and isolation procedure/device? | | ✓ | | | | |
| Change to Eye wash and/or safety showers locations? | | 1 | | | | |
| Change to PPE (gloves, clothes, eye/face protection, respirators, etc.)? | | V | | PSI , | | |
| Change to Potable Water Systems (backflow prevention/process connections)? | | 7 | | PSI | | - |
| Change to Area lighting? | | ✓ | | | | |
| Change in an RQ (Reportable Quantity) amount shipped in one package? If so, include Product Steward approval. | | 1 | | PSI | | |
| Change to Site Safety Procedures? | | ✓ | | PSI | | |
| Change in IH monitoring or safety-related handling practices for products, byproducts, or waste materials? If so, include Product Steward approval. | | ~ | | PSI . | External Approvers | |
| Change in Airborne respiratory fibers/contaminants? | | 1 | | | | |
| If the site has an approved HSE Aspects Register per SMHSE710, does the change require an adjustment to the site HSE Aspects Register? | | ~ | | | | <u>. </u> |
| Change in Emergency access to existing equipment? | | ✓ | | | | |
| Change/Addition of Fire-Proofing? | | ✓ | | PSI | | |
| Change to Emergency response planning, procedures and training? | | ✓ | | PSI-PHA | | |
| Is an ergonomic study required? | | ✓ | | PSI | | |
| New source of ignition? | | √ | | PHA | | |
| Change in product shipping mode, destination (country), packaging type, size, nonbulk to bulk or vice versa? If so, include Product Steward approval. | | ✓ | | PSI | | |
| Change in application of existing or need for new Pollution detection systems? | | ✓ | | PSI | | |
| Change to Generate any additional wastewater or solid waste? | | ✓ | | PSI-PHA | | |
| Change in Fire water system (underground mains, risers, sprinkler density)? | | ✓ | | PSI | | |

| | | | |
|---|------|-----|--|
| Change noise level in area above 90 decibels? | ✓ | PSI | |

* Whenever any item is marked "Yes" the Metropolis Health, Safety & Environmental - Mandatory must approve the change. Whenever an item maked "PSI" has a check in the "Yes"box, the Health Safety And Environmental - Mandatory needs to complete a PSSR form.

| lealth Physics | RFC#101 | | | | | | | |
|---|---------|----------|--------------------|------------------------|-------------------------------------|----------|--|--|
| Does this change impact? | Yes | No | I don't know | PHA and/or PSI * | Secondary Department Approval | Comments | | |
| Is there an increase in potential radiological exposure? | | ~ | | PSI-PHA | | | | |
| Is there a need for radiological or industrial hygiene monitoring? | | √ | | PHA | | | | |
| Change in Airborne respiratory fibers/contaminants? | | ~ | | | | | | |
| Change to Emergency response planning, procedures and training? | | ✓ | | PSI-PHA | | | | |
| Change in IH monitoring or safety-related handling practices for products, byproducts, or waste materials? If so, include Product Steward approval. | | 4 | | PSI | External Approvers | | | |
| Change to Nuclear or other radiation sources? | | ~ | , - | PSI | | | | |
| Will DOT or Hazardous Communication labels and handling instructions have to be changed? | | ~ | | PSI | | | | |
| Is there an increase in exposure potential to toxic/hazardous chemicals? | | 1 | | PSI-PHA | | | | |
| Are Decommissioning Cost Estimate changes required? | | | | | | | | |

* Whenever any item is marked "Yes" the Health Physics must approve the change. Whenever an item maked "PSI" has a check in the "Yes"box, the Health Physics needs to complete a PSSR form.

| Env | vironmental | RFC#101711780 | | | | | |
|-----|--|---------------|----------|--------------------|------------------------|-------------------------------------|----------|
| | Does this change impact? | Yes | No | I don't know | PHA and/or PSI * | Secondary Department Approval | Comments |
| | Will there be any impact on the plant neighbors - noise, odor, etc. ? | | 1 | | PSI-PHA | | |
| | Change to Generate any additional wastewater or solid waste? | | √ | | PSI-PHA | | |
| | Is a permit application or modification required? | | 1 | | PSI | | |
| | Change to Containment curbs / diking (new/modified)? | | Ý | | PSI | | |
| | Would this RFC introduce a new chemical or modify a process or storage of ammonia, hydrofluoric acid, or fluorine? | | ✓ | | PSI-PHA | | |
| | Potential release or increased emissions to air, water and/or soil? | | √ | | PSI | | |
| | Change in application of existing or need for new Pollution detection systems | s? | ✓ | | PSI | | |

* Whenever any item is marked "Yes" the Environmental must approve the change. Whenever an item maked "PSI" has a check in the "Yes"box, the Environmental needs to complete a PSSR form.

| Reg | ulatory Affairs - Right of Approval | | • | | | RFC# | 101711780 |
|-----|---|-----|----------|--------------------|------------------------|-------------------------------------|-----------|
| | Does this change impact? | Yes | No | I don't know | PHA and/or PSI * | Secondary Department Approval | Comments |
| | A. Does the change involve or impact any License Related System or Component (LRSC)? | | ✓ | | | | |
| | B. Does the change involve or impact any procedure for systems or equipment listed in MTW-ADM-OPS-0121? | | 1 | | | | |
| | C. Does the change affect the level of safety as described in the license application and/or Safety Demonstration Report? | | 1 | | | | |
| ć | D. Does the change create any new types of accident sequences that, unless mitigated or prevented, would exceed regulatory requirements and that have not previously been described in the ISA? (Justify NO answers in Comments Box, as needed) | | 1 | | | | |
| | E. Does the change use new processes, technologies, or control systems for which Honeywell-MTW has no prior experience? (Justify NO answers in Comments Box, as needed) | | 1 | | | | |
| | F. Does the change remove a Plant Feature and Procedure (PFAP) relied on for safety, as listed in the MTW-ISA, without a replacement PFAP that is at least equivalent? (Justify NO answers in Comments Box as needed) | | ~ | | | | |
| | G. Does the change alter any item relied on for safety, as listed in the MTW-ISA, that is the sole item preventing or mitigating an accident sequence (PFAP-Class A) that exceeds regulatory requirements? (Justify NO answers in Comments Box as needed) | | 1 | | | | |
| | H. Does the change create any condition or configuration that is otherwise prohibited by the MTW Source Materials License, license condition, or order (and/or 10CFR40)? (Justify NO answers in Comments Box as needed) | | √ | | | | |
| | Are changes to the license application, ISA Summary and/or SDR required? (List affected license documents in Comments as needed) | | 1 | | | | |
| | J. Will this change require an amendment to the NRC license? | | ✓ | | | | |

* Whenever any item is marked "Yes" the Regulatory Affairs - Right of Approval must approve the change. Whenever an item maked "PSI" has a check in the "Yes"box, the License Compliance needs to complete a PSSR form.

| Ma | Maintenance and Reliability | | | | RFC#101711780 | | |
|----|--|-----|----------|--------------------|---------------|-------------------------------------|----------|
| | Does this change impact? | Yes | No | I don't know | · · | Secondary Department Approval | Comments |
| | Change to Area electrical classification? | | ✓ | | PSI | | _ |
| | Change involving Emergency shutoff valves/equipment or interlocks? | | ✓ | | PSI-PHA | | |
| | Change in Equipment spare parts list (Bill of Material)? | | ✓ | | PSI . | | |
| | Change in Stores consignment materials (not replacement-in-kind)? | | ✓ | | PSI | | |
| | Change of Relief Device design/capacity (including addition of isolation valve beneath)? | | √ | | PSI-PHA | | |
| | Change in Pressure Vessel status (re-rating)? | | ✓ | | PSI-PHA | | |
| | Change of Equipment inspection frequency? | | √ | | PSI | | |

* Whenever any item is marked "Yes" the Maintenance and Reliability must approve the change. Whenever an item maked "PSI" has a check in the "Yes"box, the Maintenance - Reliability needs to complete a PSSR form.

Close

| | S | TANDARD OPERATING PROCEDURE | |
|---------------|----------|-----------------------------|--------------|
| Use Category: | II (Ref) | MTW-SOP-LF2-9016 | Page 1 of 12 |
| ` | LF2 SE | CTION 16 - INTRODUCTION | Revision 3 |

The original signatures are maintained on file.

| POSITION/O | DRG DELEGATE | I | DATE |
|---|--|-------------------|-------------------|
| Engineering [Technical Authority] | Brent Powers | 4/2 | 21/2009 |
| Procedure Writer | Ray Boren | 4/2 | 21/2009 |
| Fluorine Products [Approval Authority] | Ken Babcock | | |
| | MODIFICATION LOG | | |
| Revision Number | Description of Change | Pages Affected | Effective Date |
| 1 | Transferred to Interim Format | All | |
| 2 | Minor Administrative: Administrative change to title in header and pressure in step 16.2.7.6 | 10 | 10/22/07 |
| 3 | Minor Revision: Update section 16.2.5 to reflect actual nitrogen operating pressure on the cold trap now as 15-20 psig. Change pump number in section 16.2.8.2 to P-270. | 6, 11 | |
| | | | |

Next 1-yr. Periodic Review Date – 3/20/2010

| | S | TANDARD OPERATING PROCEDURE | |
|---------------|----------|-----------------------------|--------------|
| Use Category: | II (Ref) | MTW-SOP-LF2-9016 | Page 2 of 12 |
| | LF2 SEC | CTION 16 - INTRODUCTION | Revision 3 |

16.0 Introduction

The Liquid Fluorine unit converts gaseous fluorine into the liquid state. The basic reason for liquefying fluorine is to purify the product. The liquid fluorine produced is stored in special tanks and utilized in-plant as raw material in IF_5 and SbF_5 production.

The purpose of this manual is to describe the technique and process equipment employed in the production of liquid fluorine. Detailed operating procedures are provided to assure safe and reliable operation of the unit. Miscellaneous information necessary for the safe handling and storage of liquid fluorine is also included.

16.1 Process Description

Crude fluorine gas produced by electrolytic cells contains impurities inherent in its generation, specifically cell mist, HF, CF₄, O₂, O₃, and OF₂. All of these components have boiling points higher than that of fluorine, making it possible to purify fluorine through the condensation process. Removal of these contaminants is essential not only for attaining required product purity, but also for the safe and reliable operation of the unit.

The condensation or "collapse" of fluorine gas supplies the driving force for gas flow from the Fluorine Plant to the Liquid Fluorine unit.

Accumulation of non-condensibles in the storage tank will result in the reduction of the driving force for gaseous fluorine flow. Non-condensibles (O₂, N₂, CF₄) entering the storage tank must be removed periodically by aspirating the storage tank through the vapor access line. The unit contains no moving parts and in simplest terms consists of five heat exchangers in series, plus a storage tank.

Since ozone (O₃) is known to be an unstable compound when liquefied, a **decomposer** has been installed as the first piece of equipment in the process flow scheme. The gas mixture is heated to 600-650°F in a monel pipe equipped with electrical heaters to decompose trace quantities of ozone (O₃ starts to decompose at 482°F) that may be present in the gas stream. Gas leaving the decomposer is then cooled to ambient temperature by a water cooled **hairpin** heat exchanger.

| | S | TANDARD OPERATING PROCEDURE | |
|---------------|----------|-----------------------------|--------------|
| Use Category: | II (Ref) | MTW-SOP-LF2-9016 | Page 3 of 12 |
| | LF2 SE | CTION 16 - INTRODUCTION | Revision 3 |

After the gas has been cooled to ambient temperature, it passes through the **precooler**. The precooler lowers the temperature of the gas to approximately 0 to -20°F. At this temperature, some of the HF will condense and be separated from the gas stream. After the gas leaves the precooler, it enters the **cold trap** that is maintained at -285°F to -300°F. At this point, most of the HF is removed from the fluorine gas because the temperature is well below the freezing point of HF. Partial condensation of CF₄ and OF₂, if present in large quantities, also occurs in the cold trap.

Liquefaction of fluorine starts in the **precondenser** that is maintained at -320°F (F₂ liquefies at -306°F). When the gas reaches the precondenser, the remaining trace amounts of HF, CF₄, and other impurities become dissolved in the liquid fluorine and pass into the storage tank. For this reason, it is important to remove all the impurities possible before they reach the precondenser in order to minimize the amount of impurities dissolved in the liquid fluorine. Liquid fluorine in the storage tank must not contain more than 1.0% total impurities. The following is a typical assay of liquid fluorine:

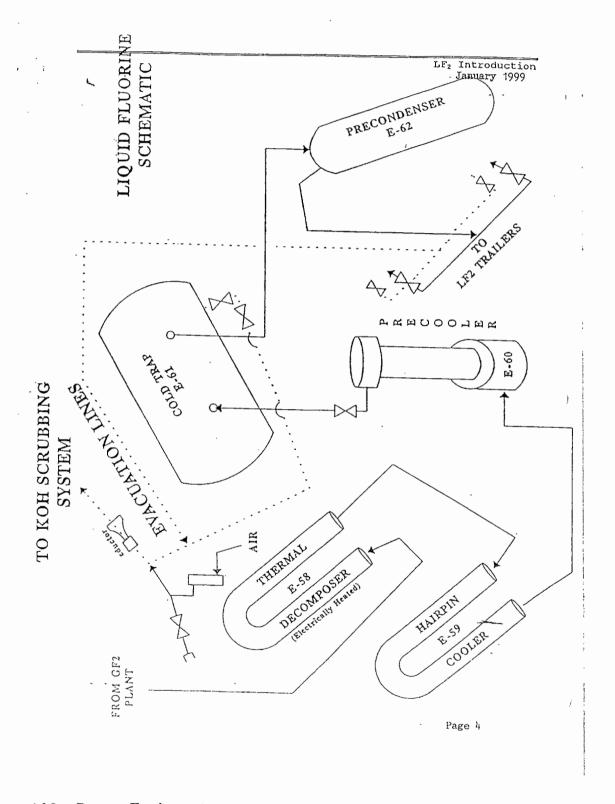
HF: 0.04 - 0.1 Wt. %

CF₄: 0.01 - 0.05 Wt. %

 $O_2 + N_2$: 0.1 - 0.9 Wt. %

The storage tanks provide final cooling and equilibrium of the liquid fluorine, hence the high nitrogen venting during fill operations.

| | Si | TANDARD OPERATING PROCEDURE | |
|---------------|----------|-----------------------------|--------------|
| Use Category: | II (Ref) | MTW-SOP-LF2-9016 | Page 4 of 12 |
| | LF2 SE | CTION 16 - INTRODUCTION | Revision 3 |



16.2 Process Equipment

DRAFT 04/21/09

| | Si | TANDARD OPERATING PROCEDURE | |
|----------------------|----------|-----------------------------|--------------|
| Use Category: | II (Ref) | MTW-SOP-LF2-9016 | Page 5 of 12 |
| | LF2 SEC | CTION 16 - INTRODUCTION | Revision 3 |

16.2.1 Gaseous Fluorine Transfer Line

Crude gaseous fluorine is supplied to the Liquid Fluorine unit through a 4" mild steel line. At the Fluorine Plant, this line is equipped with an air operated control valve for throttling the gas flow and protecting the cells from excessive minus. This valve is normally set to maintain an upstream pressure of approximately 1" H_2O pressure and a downstream pressure less than atmospheric. Also, in the fluorine line at the Fluorine Plant is a control valve that protects the cells from excessive pressure. This valve opens upon sensing a positive pressure of 5" H_2O .

16.2.2 Thermal Decomposer (E-58)

(This gas heater consists of 22 ft. of concentric 3" and 4" monel pipe arranged as a 10 ft. U bend with the fluorine flowing through the annulus and strapped externally with eighteen (18) 3000 KW electrical heaters.) The temperature of the outlet gas is controlled at 600°F by two temperature controllers (North and South) which vary the heat input based on decomposer skin temperatures. A low exit temperature alarm will occur if the temperature drops to 500°F or below during normal operation. This condition will also shut down the rectifier at the South Fluorine plant. This is given as alarm point #8 on the LF₂ alarm panel. A high temperature override is also provided to protect the equipment from extremely high temperatures. The fluorine gas is contained inside the 4" pipe, with monel tubing wound helically around the 3" liner within the annulus. This improves the heat transfer sufficiently to assure thermal equilibrium.

16.2.3 Gas Cooler (E-59)

This hairpin shaped cooler is made from 25 ft. of 6" monel pipe and follows the decomposer. The cooler is equipped with a manually controlled water spray to facilitate cooling of the fluorine gas. Cooling water from the hairpin cooler drains to the process sewer.

| | ST | ANDARD OPERATING PROCEDURE | |
|---------------|----------|----------------------------|--------------|
| Use Category: | II (Ref) | MTW-SOP-LF2-9016 | Page 6 of 12 |
| | LF2 SEC | TION 16 - INTRODUCTION | Revision 3 |

16.2.4 **Precooler (E-60)**

This vessel consists of an externally finned monel pipe 10 ft. long and 8" in diameter, surrounded by a monel jacket 21" in diameter. Fluorine gas circulates over the finned pipe, making one pass through the vessel. The fluorine is cooled to 0 to -20°F by cold nitrogen "waste" gas from the cold trap passing within the inner pipe before being discharged to the atmosphere. The nitrogen vent line is equipped with a weep hole to prevent accumulation of rain water inside the precooler.

16.2.5 Cold Trap (E-61)

This vessel is basically a shell and tube heat exchanger with the tube bundle made of 24 monel tubes each making four passes through the vessel. The tube bundle is surrounded by an inner shell of monel and an outer shell of steel. The fluorine gas passes through the baffled inner shell and is cooled to -285°F to -300°F by liquid nitrogen circulating through the tubes at approximately 15-20 psig. (At lower nitrogen pressures, fluorine will start to condense and accumulate in the cold trap.) The space between the inner shell and the outer shell is a vacuum jacket filled with Perlite insulation.

The cold trap is equipped with low temperature, high temperature, and high pressure alarms. Activation of either the low temperature or the high temperature alarm will shut down the rectifer at the South Fluorine plant. The low temperature alarm was installed to prevent liquefaction of F_2 in the cold trap. Both the high temperature and high-pressure alarms warn the operator of any unusual activity in the cold trap.

| | S | ANDARD OPERATING PROCEDURE | |
|---------------|----------|----------------------------|--------------|
| Use Category: | II (Ref) | MTW-SOP-LF2-9016 | Page 7 of 12 |
| | LF2 SEC | CTION 16 - INTRODUCTION | Revision 3 |

16.2.6 Precondenser (E-62)

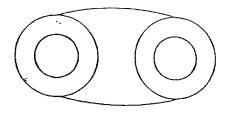
The precondenser is also a vacuum jacketed shell and tube heat exchanger. The tube bundle consist of twelve (12) 1" stainless steel tubes each making a double pass through the vessel. The fluorine is condensed in the tubes by liquid nitrogen circulating in the baffled shell side. The liquid fluorine is then allowed to gravity drain to the storage tank through the fluorine fill line. The fluorine vessels (precondenser, cold trap and precooler) are protected from excessive nitrogen pressure by relief valves on the nitrogen vent lines. The nitrogen vent line is equipped with a drop leg to protect personnel from liquid nitrogen "rain". No pressure relief devices are provided on the fluorine sides of these vessels.

| | ST | ANDARD OPERATING PROCEDURE | |
|---------------|----------|----------------------------|--------------|
| Use Category: | II (Ref) | MTW-SOP-LF2-9016 | Page 8 of 12 |
| | LF2 SEC | TION 16 - INTRODUCTION | Revision 3 |

CROSS SECTIONS OF LF2 EQUIPMENT

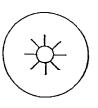
LF₂ Introduction January 1999

DECOMPOSER GASEOUS FLUORINE IN ANNULUS



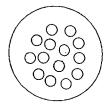
PRECOOLER

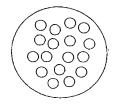
GASEOUS FLUORINE IN ANNULUS



COLD TRAP

GASEOUS FLUORINE IN SHELL SIDE





PRECONDENSER

LIQUID FLUORINE INSIDE TUBES

Page 9

DRAFT 04/21/09

| STANDARD OPERATING PROCEDURE | | | | | |
|--|----------|------------------|--------------|--|--|
| Use Category: | II (Ref) | MTW-SOP-LF2-9016 | Page 9 of 12 | | |
| LF2 SECTION 16 - INTRODUCTION Revision 3 | | | | | |

- **16.2.7** Liquid Fluorine Storage tanks (T-185, T-197, T-571 and T-3107)
 - 16.2.7.1 The storage tanks are essentially 5000 lbs. capacity tanks (monel or 304 stainless steel) housed in 304 stainless steel tanks, which in turn rest in steel vacuum jackets. The inner fluorine tank is roughly 42" in diameter by 7 ft. long with a volume of approximately 500 gallons. The intermediate liquid nitrogen tank is 4 ft. in diameter by 9 1/2 ft. long, providing a 340 gallon annulus around the fluorine tank for nitrogen coolant. The outer vacuum jacket is 4 1/2 ft. in diameter by 11 ft. long, and filled with Perlite insulation.
 - **16.2.7.2** Design data for the shells are:
 - 16.2.7.2.1 Outer vacuum jacket: 10 psig internal and 15 psig external pressure at -20°F to 650°F.
 - 16.2.7.2.2 Intermediate nitrogen shell: 45 psig internal and 10 psig external pressure at -320°F to 80°F.
 - 16.2.7.2.3 Inner Fluorine tank: 70 psig internal and 45 psig external pressure at -320°F to 80°F.
 - 16.2.7.3 The fluorine vapor phase access piping consists of a 1" line with double valves and enters the inner tank at the top. The liquid phase access is a 1" line, double valved, and also enters at the top of the tank with a 1" dipline extended to the bottom of the fluorine vessel. Vapor phase access is provided for removal of non-condensibles and subsequent pressurization of the storage tank with helium. Top entering lines are used for safety in case of failures of the entry joints. Fluorine valves and piping are all monel. Inboard liquid phase and vapor phase valves are equipped with pneumatic operators for remote, manual shutoff in case of an emergency.

| STANDARD OPERATING PROCEDURE | | | | | |
|--|----------|------------------|---------------|--|--|
| Use Category: | II (Ref) | MTW-SOP-LF2-9016 | Page 10 of 12 | | |
| LF2 SECTION 16 - INTRODUCTION Revision 3 | | | | | |

- 16.2.7.4 The liquid nitrogen coolant piping consists of three separate lines:
 - 16.2.7.4.1 A 1 1/2" feed line entering at the top of the liquid nitrogen tank.
 - 16.2.7.4.2 A 1 1/2" drain line from the bottom of the tank.
 - 16.2.7.4.3 A 2" gaseous vent line from the top of the tank. All nitrogen piping is stainless steel. The valves are bronze with packing, and designed for cryogenic service. Relief valves and rupture discs are provided on nitrogen feed and vent lines for safety.
- 16.2.7.5 The vacuum jacket relief assembly consists of an "O" ring sealed 6" blank flange, serving as a spring-loaded relief disc. The tank is also supplied with an evacuation valve and vacuum probe assembly.
- 16.2.7.6 Instrumentation incorporated within the instrument hood at the rear of the tank assembly includes fluorine and nitrogen pressure gauges, a level indicator for the liquid nitrogen level, and a 12 volt dc alarm system to indicate high product pressure (>15 psig) and low liquid nitrogen level (<190 gallons). Pressure taps are on the line to the respective tanks and not directly on the tanks.
- **16.2.7.7** The entire three-tank assembly with its instrumentation housing is mounted on load cells and concrete piers.

16.2.8 Vent Stacking System

16.2.8.1 Fluorine and HF containing gases evacuated from the Liquid Fluorine unit are both hazardous and toxic, hence requiring neutralization before being vented to the atmosphere. The Liquid Fluorine scrubber assures effective neutralization by contacting the gas with aqueous KOH solution.

| STANDARD OPERATING PROCEDURE | | | | | | |
|------------------------------|----------|-------------------------|---------------|--|--|--|
| Use Category: | II (Ref) | MTW-SOP-LF2-9016 | Page 11 of 12 | | | |
| | LF2 SE | CTION 16 - INTRODUCTION | Revision 3 | | | |

16.2.8.2 The scrubbing system consists of an air eductor which provides for the evacuation of gases from the Liquid Fluorine unit components, a KOH jet nozzle (P-303) delivering 15-20 gpm for initial neutralization, a packed tower (T-200) containing 1" stainless steel hi-flow rings with a 30-40 gpm counter-current flow of KOH, an 800 gallon cone-bottom pump tank/settler (U-221), and two KOH circulating pumps (P-270/P-271), each with a capacity of 60 gpm. KOH flows are determined by vortex flowmeters at the pump discharge line. Alarms are provided to warn operators of low KOH flow. A low air flow to eductor alarm and automatic shut off valve are also provided to prevent KOH backflow to the LF₂ storage tank or other F₂ vessels at the LF₂ unit.

16.2.8.3 Spent KOH may be pumped to the SF₆ sump by the same KOH circulating pumps or drained to the trench. The LF₂ scrubber pad drains to the IF₅ sump. Both sumps are valved to the waste alkali tank (U-804) at EPF.

16.2.9 Liquid Nitrogen System

All nitrogen used in this process originates at the 13,000 gallon SCF storage tank where nitrogen is stored as a liquid under pressure after transfer from tank trucks. Total nitrogen available in SCF is 1,240,000.

16.3 Safety

Although fluorine is the most reactive element and recognized as a very dangerous material, it can be handled without undue hazards if proper precautions are taken. In order to minimize the risks involved, the following measures should be observed at all times:

16.3.1 Refer to the MTW Employee Safety Handbook for the appropriate personal protective equipment when connecting or disconnecting fluorine lines. Personal Protective Equipment must be worn when opening equipment suspected of containing "heels" of fluorine or HF.

| STANDARD OPERATING PROCEDURE | | | | | |
|--|----------|------------------|---------------|--|--|
| Use Category: | II (Ref) | MTW-SOP-LF2-9016 | Page 12 of 12 | | |
| LF2 SECTION 16 - INTRODUCTION Revision 3 | | | | | |

- 16.3.2 All equipment used in fluorine service should first be thoroughly cleaned, degreased, and then treated with increasing concentrations of fluorine gas (passivated) so that any impurity may be burned out without the simultaneous ignition of the metal. The Area Day Foreman will issue details of the passivation procedure when a new piece of equipment is installed.
- 16.3.3 Double valves on cold liquid fluorine lines should never be closed at the same time.

 Only one valve is closed first, with the second valve closed only after the line between the two valves warms up to ambient temperature. Failure to follow valving order may result in hydraulic rupture of lines.
- 16.3.4 When using one valve of a double valve set for throttling, open the inboard wide and throttle with the outboard. This will permit safe shut off using the inboard in case of failure of the outboard valve, and will also permit closing off the fluorine supply to do maintenance on outboard valves.

Precaution should also be taken when handling other hazardous materials such as KOH and liquid nitrogen. Refer to the MTW Employee Safety Handbook for the appropriate personal protective equipment to be worn when sampling KOH. When handling liquid nitrogen, appropriate gloves shall be worn to avoid frostbites in case of spills.

NO TRAINING IS REQUIRED FOR THIS eMOC.